

8. VERT-Forum – March 17th 2017

MEMBRANE PARTICLE FILTERS with PULSE CLEANING for MARINE and OTHER APPLICATIONS

A project proposal

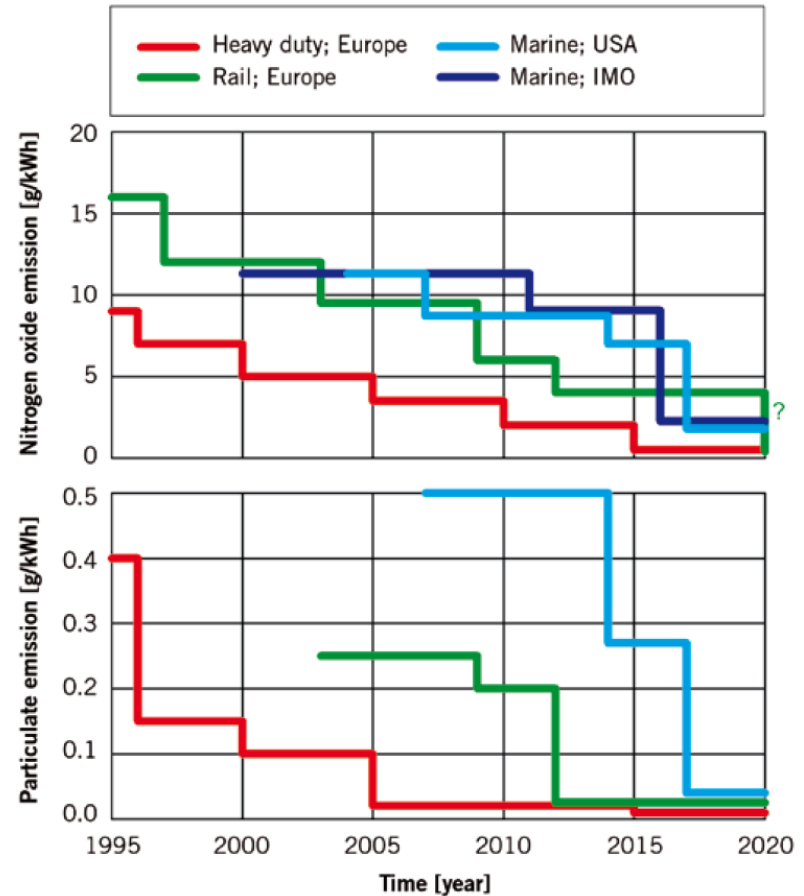
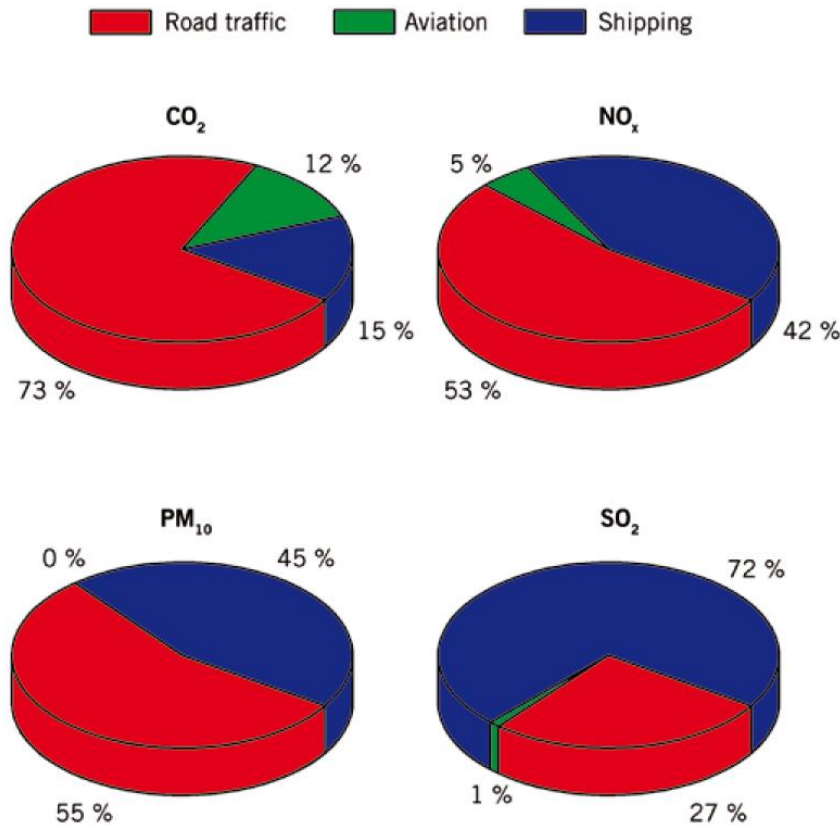
Thomas W. Lutz

BACKGROUND and TARGET

- Marine contribution to global PM-burden
- Marine diesel fuel properties → *sulfur* and *ash*
- PM characteristics
- Why not standard wall flow DPF
→ MAN experience (Lauer, 16th ETH-NPC)
- Membrane filter structure
- A membrane filter based concept

AIR POLLUTION by MARINE DIESEL ENGINES

One large ship is equal to > 50'000 trucks



ON-BOARD PM EXPOSITION

'AIDA Prima', launched 2014



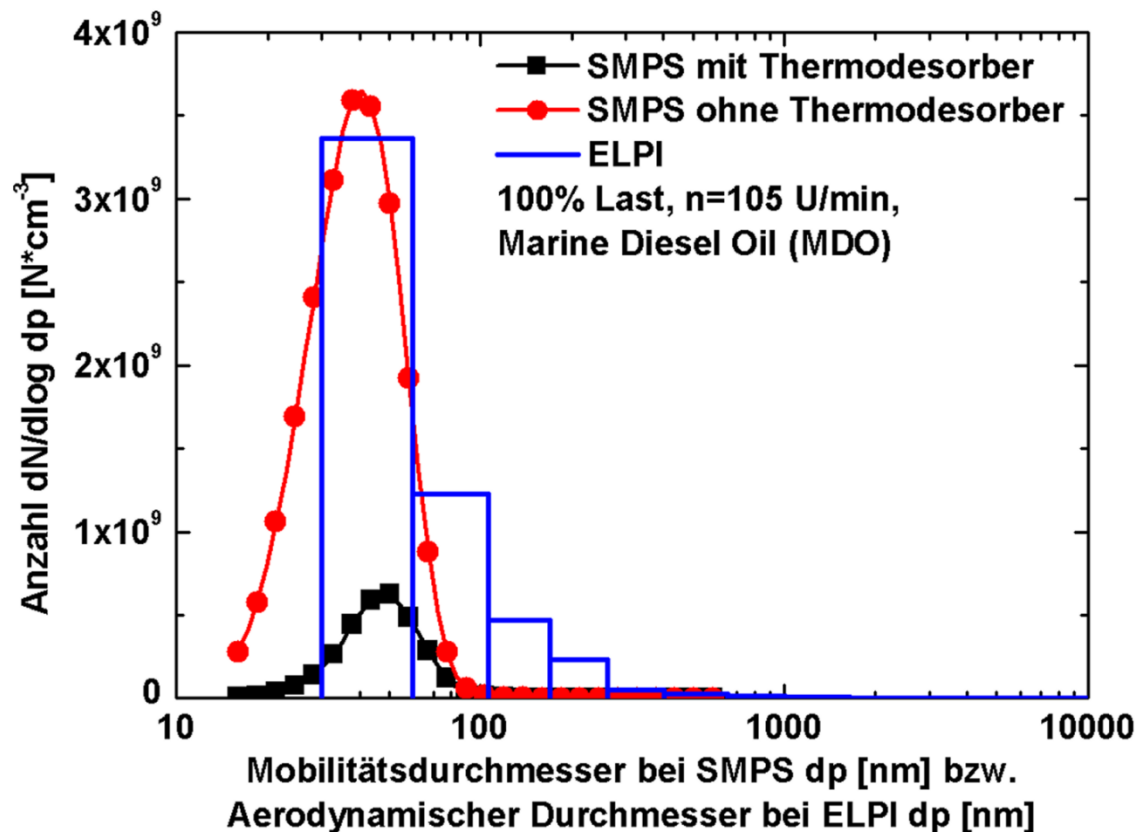
E.g. ice rink behind the stack:

Measured values:

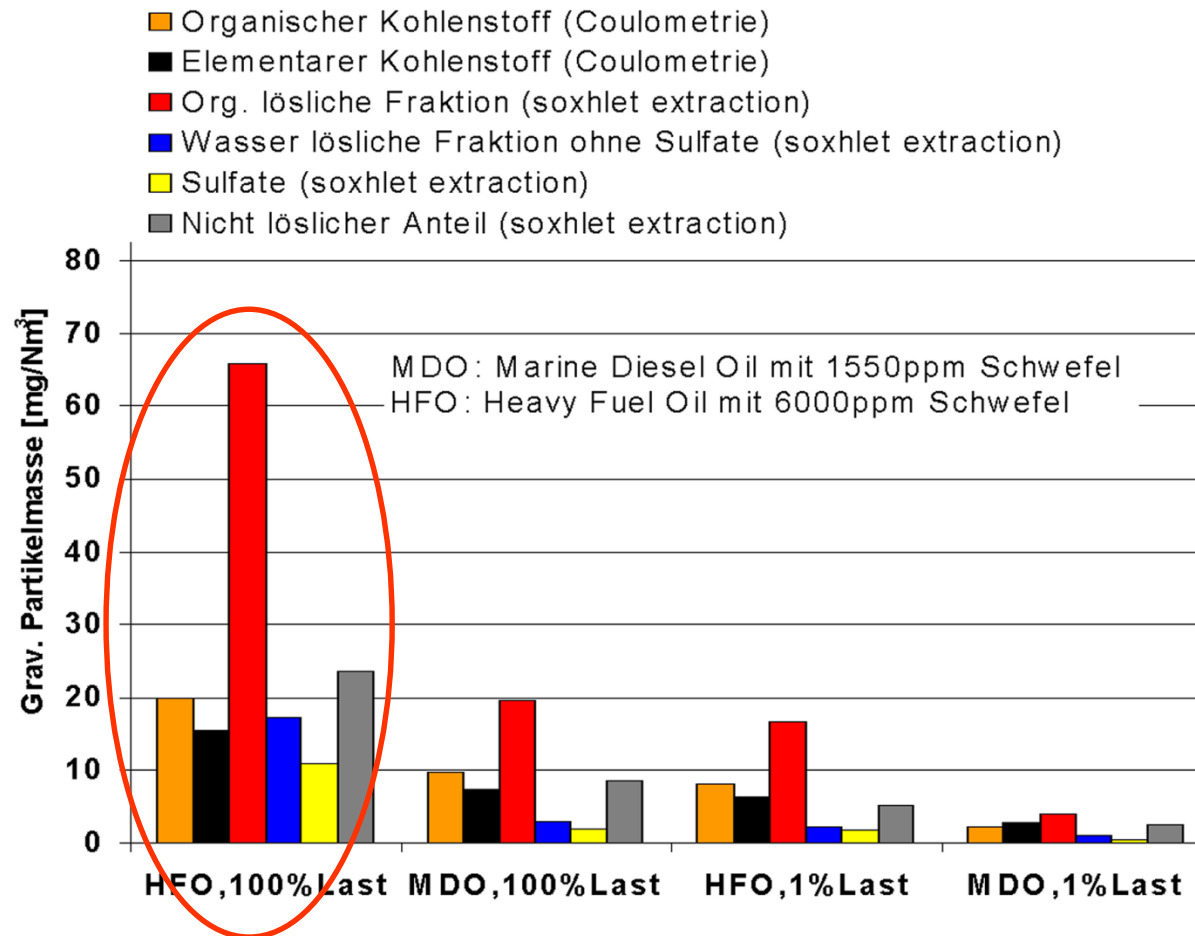
1/2-h-average: 68'000 #/cc

peak values: > 250'000 #/cc

TYPICAL PARTICLE SIZE DISTRIBUTION SULZER 4 RT-flex 58T-B - MDO



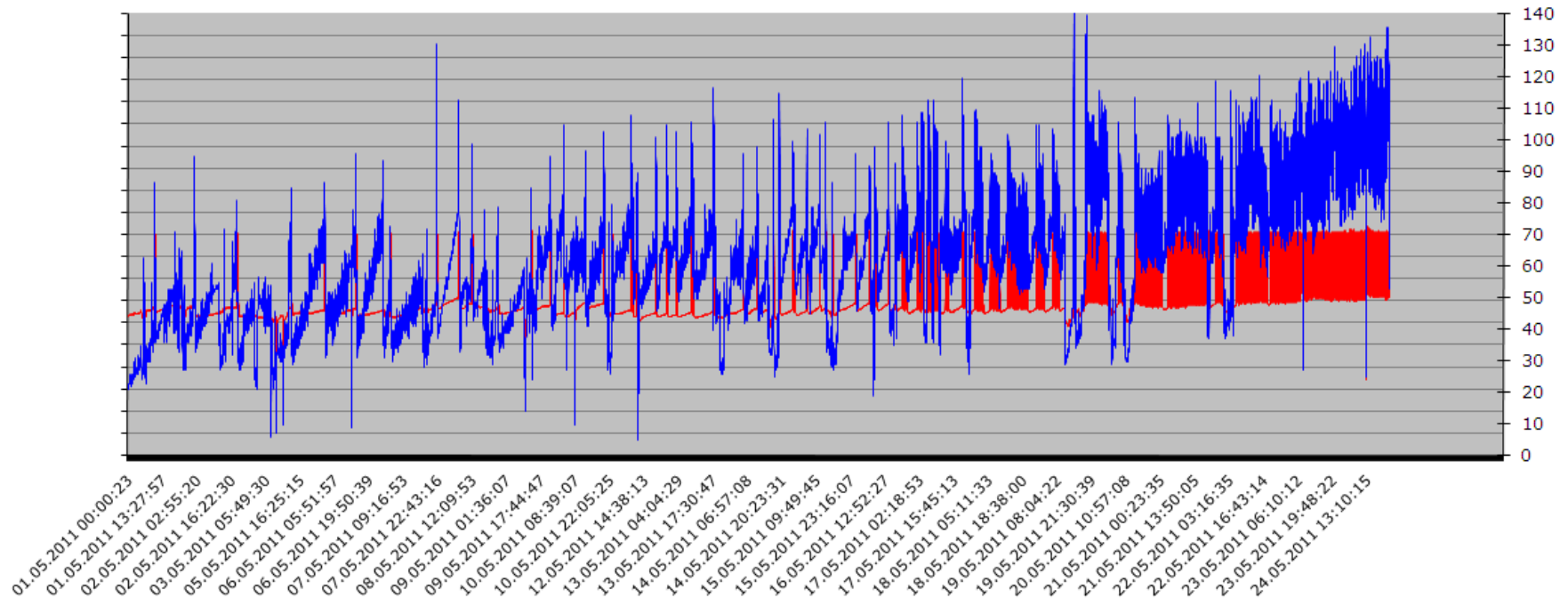
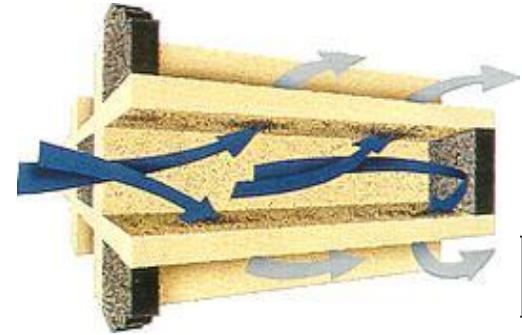
PARTICLE COMPOSITION



DPF BACKPRESSURE DEVELOPMENT

Log Results

- Backpressure mbar
- Regeneration events



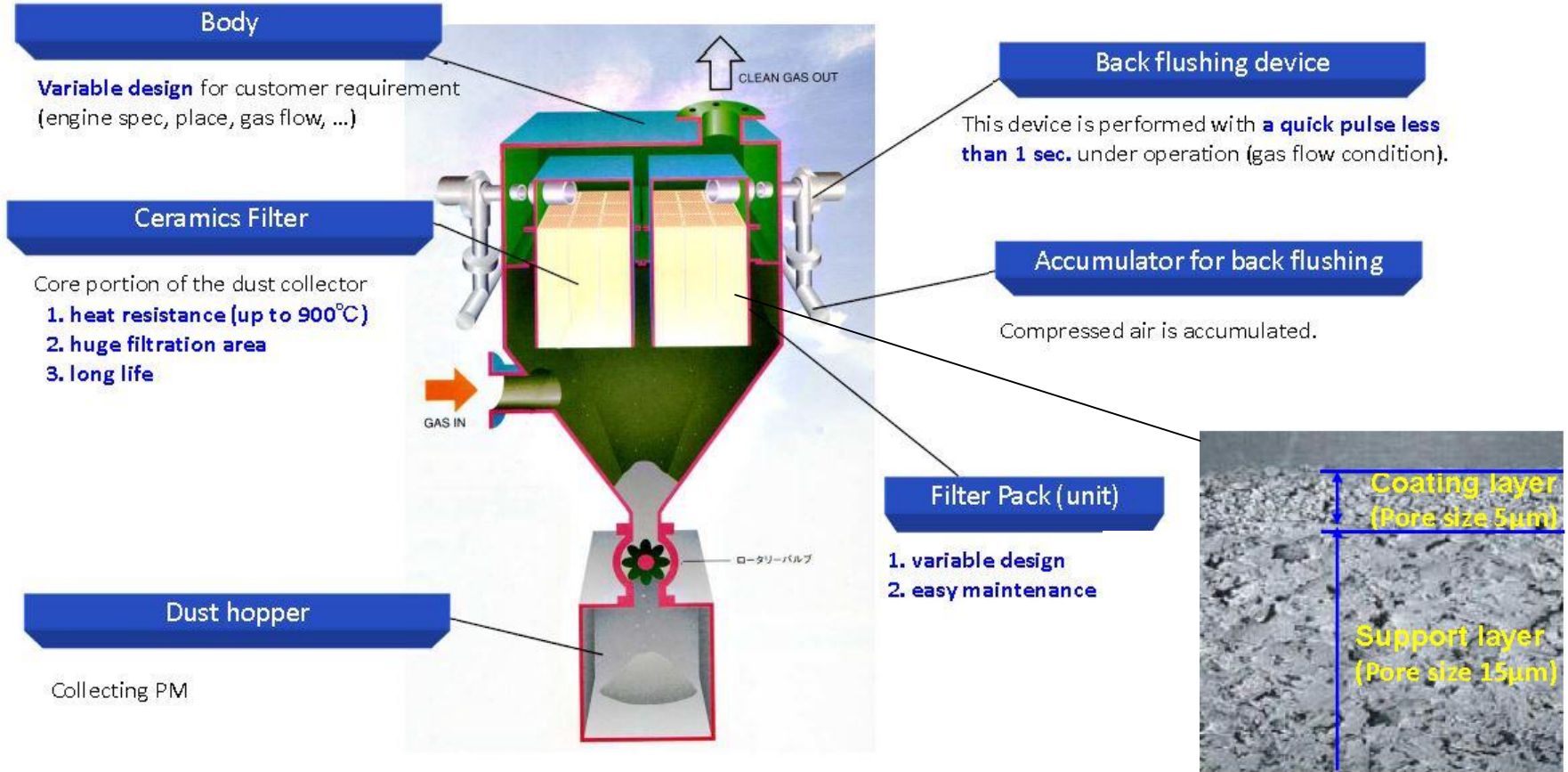
CRUCIAL REQUIREMENTS for MARINE DPF

- Sulfur tolerant $> 20'000$ ppm
- Ash tolerant > 20 times more ash than HDV
- Regeneration below 350°C (2-stroke engines)
- OC/EC $> 4 \rightarrow$ sticky particles
- DOC sulfur tolerant and not plugging
- Low backpressure (< 100 mbar)
- **Continuous soot + on site ash cleaning**

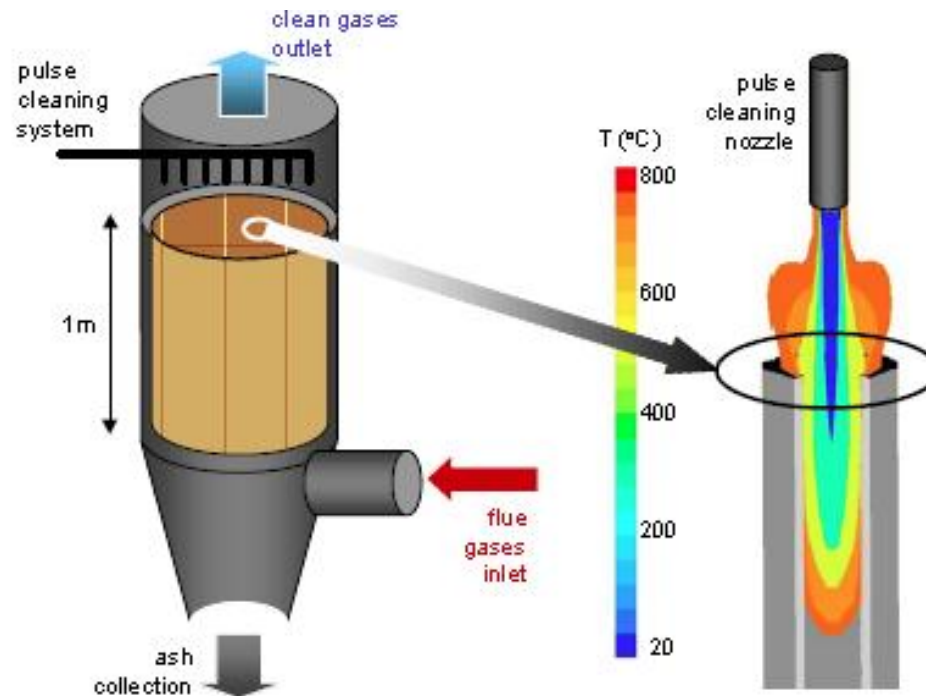


Ceramic membrane filter with pulse cleaning

DRY DUST COLLECTOR for HIGH-TEMPERATURE GASES NGK CERALLEC System



PULSE CLEANING CONCEPT



A NEW CONCEPT for a MARINE DPF SYSTEM

- **DOC**

- large pore foam structure: insensitive for plugging
- sulfur tolerant coating – and/or FBC
- converts OC → drying soot; agglomerating particles, heating gas

- **DPF**

- very fine pore membrane structure
- high space velocity permitted → small bulk size
- high frequency on site pulse cleaning to keep backpressure small
- *pressure pulse formation* and wave propagation will be *crucial*
- modular design

- **SCR**

- high cell density due to clean gas

WORK PACKAGES

Computer Simulation	Experiments AFHB and Marine Engine	Design	Time
Simulation single modul		Design DOC Substrate selection and Coating	2 Month
	Which pressure is needed for cleaning a filter wall ? AFHB		2 Month
		Design and construction of single modul	2 Month
Simulation modul pakage	Test DOC at Marine Engine Conversion, sulfur sensitivity		2 Month
	Test single modul AFHB		2 Month
		Design and Construction of modul pakage	2 Month
Refined Simulation based on experimental data	Modul pakage at Marine Engine		2 Month
	Refining pressure pulse design and experimental verification		2 Month
		Refinement of Modul pakage	2 Month
	Improved modul pakage at Marine Engine		2 Month
	Physicochemical emission test		2 Month
Final Report			

PARTNERS

- **Research Partners**
 - AFHB
 - R.Haenggi
- **Industrial Partners**
 - NGK
 - LIEBHERR
 - WIN G&D
 - Pure Clean Air
- **Financing Partners**
 - BAFU-Technologiefonds (> June 2017)
 - VERT
- **Project Management:** A. Mayer, Th. Lutz

A FINAL REMARK

The ability of *on site ash removing* from the DPF might also be an attractive solution for *construction machinery* and *locomotives*